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North Sea Hydrogen Valley Ports

Deliverable D2.8

North Sea Region Collaboration to Overcome Barriers and Foster Innovation

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Abbreviations

The following abbreviations and short forms are used in this deliverable.

Abbreviation	Definition
CCfD	Carbon contracts for difference
CSRD	Corporate Sustainability Reporting Directive
ENNOH	European Network of Network Operators for Hydrogen
ERDF	European Regional Development Fund
ETS	EU Emissions Trading System
FuelEU	FuelEU Maritime Regulation (Regulation (EU) 2023/1805)
NOGAT	Northern Offshore Gas Transport pipeline
PtX	Power-to-X
RED	Renewable Energy Directive
RFNBO	Renewable fuels of non-biological origin
TSO	Transmission system operator

1. Executive summary

The North Sea Hydrogen Valley Ports project brings together four port regions to build one connected hydrogen system rather than four separate ones. This deliverable looks at what the four share, because those shared issues matter most for the network.

A shared foundation to build on

Three enabling conditions are present in all four regions: EU and national funding for pilots and demonstrations, EU climate regulation that is raising the relative cost of fossil fuels, and active networks along the value chain.

A shared set of barriers

Five barriers are present in every region: the chicken-and-egg problem linking finance, markets and infrastructure; the absence of committed maritime offtakers; a knowledge deficit in companies and permitting authorities; the absence of operating support once pilot funding ends; and a shortage of trained operational personnel. These barriers reinforce one another, which is why they cannot be tackled one at a time or one port at a time.

The same barriers, governed differently

The barriers are the same, but national conditions differ. Denmark has publicly financed its hydrogen backbone, Germany pairs production support with demand-side instruments, the Netherlands has withdrawn budgets and deferred the backbone for port regions, and France depends almost entirely on public funding. This is why solutions cannot simply be transplanted from one national system to another.

A transnational gap that no port can close alone

Above the port level sit barriers belonging to the network itself: no mechanism to coordinate maritime demand, fragmented regulation and standards between the four countries, uneven engagement, and a legitimacy that one offtaker withdrawal can undermine. These are the barriers a coordinated network is best placed to address.

What follows from this

Transnational projects should be designed backwards from the shared barriers, with a coordinated maritime demand signal as the flagship. The network should speak to the EU with one voice on certification certainty and demand support, and develop the coordination capability its current networks lack. Aligned action across the network is the only realistic route through.

2. Introduction

2.1 Purpose and scope

The North Sea Hydrogen Valley Ports project brings together Ports of Bremen in Germany, Brest in France, Den Helder in the Netherlands and Esbjerg in Denmark to develop a roadmap for producing, storing, transporting and bunkering hydrogen and connecting it to end users (Hammou et al., 2025). The ambition is a single connected North Sea network in which the four ports reinforce one another.

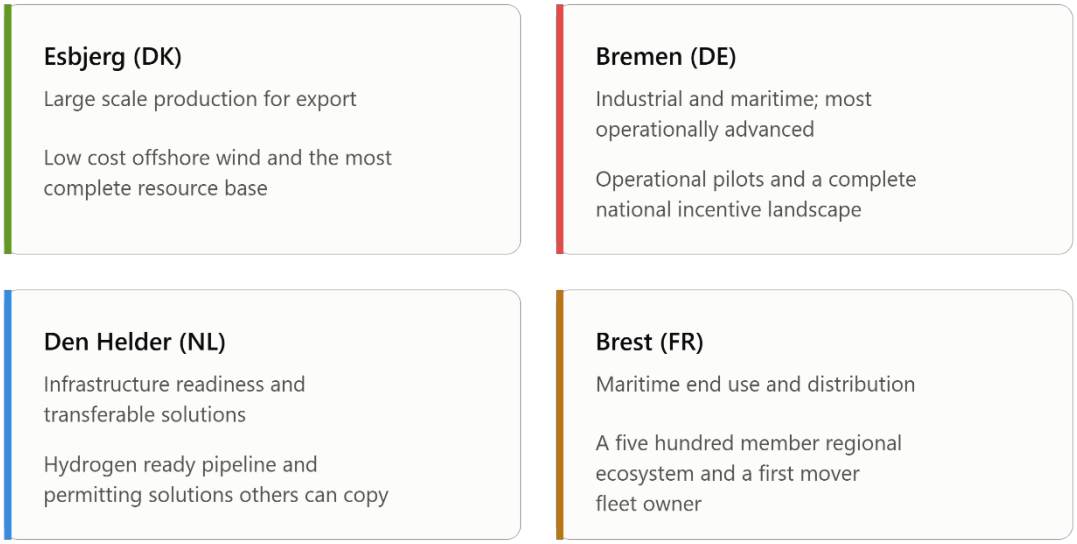


Figure 1. *The four port regions of the network.*

This deliverable identifies what the four regions hold in common and turns it into recommendations on three questions: how to develop transnational projects, how to remove governance barriers together, and how to create a wider North Sea hydrogen valleys network. It complements the individual port plans and the Hydrogen Valley Master Plan (Fontes et al., 2026). The findings draw on research conducted with New Energy Coalition within the NSH2V Ports project (van den Bunt, 2026).

3. The four port regions

3.1 Bremen, Germany

Bremen is the most infrastructure-ready of the four regions. Hydrogen buses are in service and an electrolyser is operational, giving investors practical evidence that the technology works. The region benefits from an unusually complete national incentive landscape, combining production support with demand-side support, including carbon contracts for difference for industrial offtakers. Germany's first bidding round under this instrument awarded contracts worth up to approximately EUR 2.8 billion, five of the funded projects relying on hydrogen, giving Bremen's neighbours a subsidised market to sell into.

Bremen is also advanced on permitting. Methanol bunkering is fully permitted, and that experience is being applied to ammonia bunkering procedures in cooperation with Wilhelmshaven. A digital twin of energy flows across the ports of Bremen and Bremerhaven supports precise planning of hydrogen demand and infrastructure, and public procurement of hydrogen buses has created a stable local demand niche.

Its constraints are specific rather than structural. Regulatory change during construction has already rendered a hydrogen vessel non-compliant, making investors more cautious, and full electrification is emerging as the superior option for container handling equipment, closing off a prospective market.

3.2 Brest, France

Brest is the region in which market formation is hardest. With no co-located heavy industry, maritime demand is its only realistic market, and that market has not yet formed anywhere in the network. Its backbone connection is not scheduled until 2045, so hydrogen must be moved by road or sea until then, raising distribution costs and limiting scale.

Brest nevertheless brings substantial strengths. The Bretagne Hydrogène Renouvelable network brings together approximately five hundred organisations across five clusters, giving visibility to small initiatives that would otherwise remain unseen by partners and investors. A regional public authority is acting as a first-mover fleet owner, financing the hydrogen conversion of its own vessels and leading the development of bunkering procedures, building a safety and

certification knowledge base that private actors can use. Brest also takes part in complementary projects spanning the North Sea and the Atlantic.

Its specific constraints include grant mechanisms that require companies to spend before they are reimbursed, straining the cash flow of small firms, and a vessel certification process that requires a bespoke alternative design assessment for every ship.

3.3 Den Helder, Netherlands

Den Helder's contribution centres on infrastructure readiness and transferable solutions. It has developed a customised prescription for truck-to-ship bunkering that avoids the need for a full environmental permit and is now being adopted by other Dutch ports, and it has certified the NOGAT offshore pipeline as hydrogen-suitable, turning an existing asset into distribution infrastructure. Active facilitation, with regular coordination between the port authority and the municipality, keeps regional and transnational actors connected.

Its constraints are significant and largely national in origin. Public hydrogen budgets have been withdrawn, an offshore hydrogen infrastructure programme paused and a regional subsidy scheme terminated. The national hydrogen network is being rolled out in phases that prioritise the industrial clusters, and Den Helder falls in the final phase, placing it behind Bremen and Esbjerg in backbone access. The partial withdrawal of an energy company, whose electrolyser is now for sale, has affected ecosystem credibility, and it remains unclear which authority holds permitting competence for electrolysers.

3.4 Esbjerg, Denmark

Esbjerg's competitive advantage is low-cost renewable electricity from offshore wind, the most important input into green hydrogen, given that electricity accounts for between 47 and 78 per cent of production costs. Its resource base is the most complete of the four regions, with stronger market and skills conditions than elsewhere. Its strategy is export-oriented, with hydrogen planned for pipeline delivery to German steel and chemical industries, where German offtake subsidies make it a commercially viable market.

Denmark has addressed the infrastructure deadlock at national level. The state is providing a loan of up to DKK 7.5 billion and operational support of up to DKK 10.6 billion over thirty years, lowering transport costs and the minimum booking threshold for the pipeline. This shifted the condition for access from commercial viability to a commitment to use the pipeline,

and six companies have since signed letters of intent for capacity. A sub-supply network has also screened thirty to thirty-five local companies for readiness to join the power-to-X value chain.

The constraints are timing and capacity. Offshore wind expansion has been delayed by three to four years and grid congestion prevents surplus electricity from reaching electrolysers, so low-cost production will not fully arrive until around 2030. The port authority is experiencing fatigue from repeated requests to join initiatives, and some early private participants are beginning to withdraw without market certainty.

3.5 Comparative overview

Table 1. *The four port regions at a glance.*

Port region	Primary orientation	Most distinctive strength	Most binding constraint
Bremen (DE)	Industrial and maritime; most advanced	Operational pilots, a complete incentive landscape and advanced permitting	Regulatory change mid-project; electrification outcompeting hydrogen
Brest (FR)	Maritime end use and distribution	A large regional ecosystem and a public authority acting as first-mover fleet owner	No co-located industry and no backbone connection until 2045
Den Helder (NL)	Infrastructure readiness and transfer	Transferable permitting, a hydrogen-ready pipeline and active facilitation	Withdrawn national budgets and a backbone connection in the final roll-out phase
Esbjerg (DK)	Large-scale production for export	Low-cost offshore wind, the most complete resource base and state-backed backbone financing	Delayed wind build-out and grid congestion until around 2030

4. Common features across the four regions

> *Beneath four different national systems lies one common structure. The same conditions help the ports build, and the same barriers hold them back. This is what makes collaboration not merely useful but necessary.*

4.1 The shared enabling foundation

Three enabling conditions are present in all four port regions (van den Bunt, 2026).

- **EU and national funding instruments.** Interreg, the EU Innovation Fund, the European Hydrogen Bank and national schemes account for the current level of activity. Interreg North Sea co-finances up to 60 per cent of project costs and requires partners from at least three countries, building networks as a by-product of funding (Interreg North Sea, n.d.).
- **EU climate regulation.** The EU Emissions Trading System, FuelEU Maritime, the Renewable Energy Directive and the Corporate Sustainability Reporting Directive together raise the relative cost of fossil fuels. FuelEU Maritime requires the greenhouse gas intensity of ship energy to fall by 2 per cent from 2025 and by up to 80 per cent by 2050 (Regulation (EU) 2023/1805).
- **Active networks along the value chain.** Local, regional and transnational platforms connect actors who would otherwise not meet and build the relationships on which future coordination depends.

Operational demonstrations, planned backbone connections and public authorities absorbing early risk are each present in three of the four regions. No single region holds every advantage, and each has something the others need.

4.2 The shared barriers

Five barriers are present in all four port regions. They stem from structural gaps rather than local circumstances, which is why no single port can resolve them alone (van den Bunt, 2026).

1. **The chicken-and-egg problem between finance, markets and infrastructure.** Offtakers will not commit without an affordable price, which requires large-scale production, which requires infrastructure, which requires revenue certainty from committed offtakers.

2. **The absence of committed maritime offtakers.** Without them, bunkering infrastructure is not built, hydrogen is not produced and hydrogen vessels are not ordered.
3. **A knowledge deficit in companies and permitting authorities.** Many Companies, especially SME's entering the market sometimes lack the knowledge to raise finance and navigate permitting, while many local authorities are still new to the frameworks to evaluate hydrogen projects, which slows approvals.
4. **The structural absence of operating support.** Funding covers capital costs, but when it ends projects face operating costs the market cannot yet cover, and EU state aid rules make this gap difficult to bridge nationally.
5. **A shortage of trained operational personnel.** Technicians, port safety staff and trained vessel crews are scarce everywhere, which raises the perceived risk of projects and delays the experience that would resolve it.

Three further barriers are present in three of the four regions: regulatory uncertainty around the certification of renewable fuels of non-biological origin, competition from faster-maturing alternatives such as LNG, methanol and electrification, and a first-mover disadvantage that discourages early commitment.

4.3 How the barriers interact

The shared barriers are not independent of one another. Without committed offtakers, investment, new entrants and confidence in hydrogen all remain limited, and that in turn keeps offtakers from committing. This is why the network remains at the pilot stage despite strong knowledge and networks, and why the recommendations in this document seeks to address several barriers at once rather than any single one. National conditions shape how strongly each barrier is felt in each region, so network-level action needs to be matched by national adjustments.

4.4 The transnational governance gap

Above the port level sits a layer of barriers that belongs to the network as a whole and is most directly within its reach.

- **No mechanism to coordinate demand.** No port alone justifies bunkering investment, yet no structure converts four small demands into one credible signal, so the chicken-and-egg problem is reproduced at network scale.
- **Fragmented regulation between the four countries.** Each country implements EU directives, certification and hydrogen quality standards differently, which no port can resolve within its own system.
- **Uneven strategic engagement.** Some actors take part with a clear agenda while others attend mainly for visibility.
- **Fragile legitimacy.** The withdrawal of a single large offtaker can bring down an entire valley.

5. Recommendations

The barriers identified are shared, systemic and interlocking, and therefore the recommendations follow that logic. They are organised around three tasks: developing transnational projects, removing governance barriers together, and creating a wider North Sea hydrogen valleys network. The network cannot resolve the structural barriers alone, but it can shape demand, share knowledge, harmonise practice and speak with one voice.

5.1 Developing transnational projects

5.1.1 Start from the shared barriers, not the individual port plans

Multi-partner projects tend to coordinate what each partner was already planning. The opposite is needed: because the most damaging barriers are shared, they should become the organising principle, with projects designed backwards from them. In the Dutch-German border region, more than two hundred hydrogen organisations are active but only three cross-border projects were running (Fontes et al., 2026).

5.1.2 Create a coordinated North Sea maritime hydrogen demand signal

This is the most important transnational project the network can pursue. No individual port generates enough maritime demand to justify bunkering infrastructure. A mechanism in which the four ports collectively commit to a minimum bunkering volume would create the market signal that investment requires. Turning this into a signed and quantified commitment should be the network's flagship undertaking.

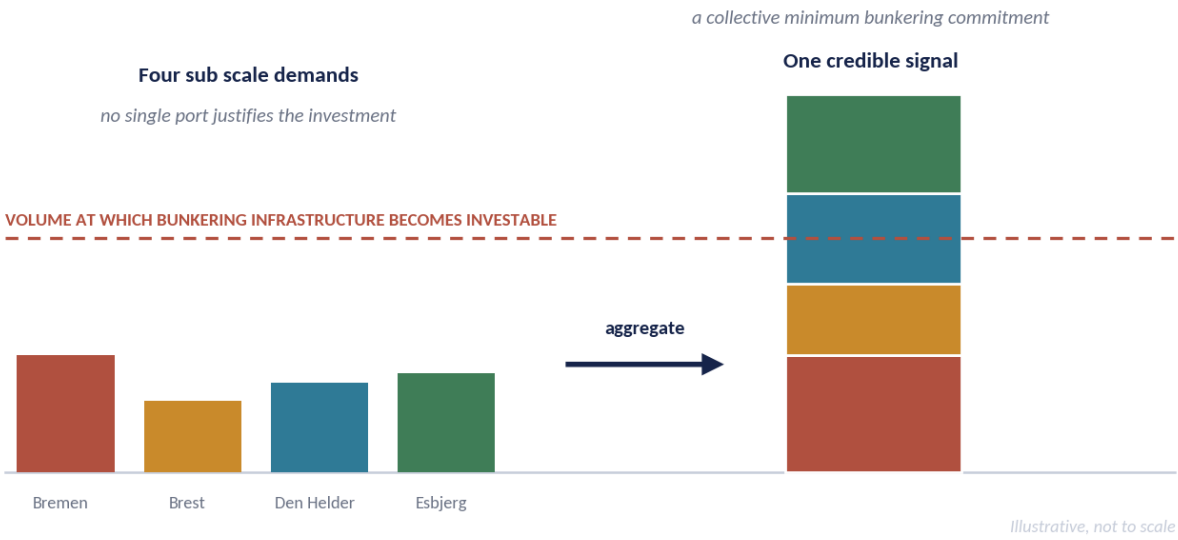


Figure 2. *Demand aggregation converts four sub-scale markets into one credible market signal.*

5.1.3 Roll out staged bunkering and share the operational learning

Operational solutions such as the Den Helder truck-to-ship prescription and the Brest certification experience transfer directly between ports but are not yet systematically shared. A staged, modular bunkering roll-out across all four ports, starting with truck-to-ship and scaling with demand, should be paired with a shared safety and technical database and an exchange of operational personnel, which would also help relieve the shortage of trained staff.

5.1.4 Build joint permitting roadmaps into every project from the start

Governance should be a core planning task from the start of each project. Permitting competence for hydrogen installations is unclear in the Netherlands, every hydrogen vessel in France needs a separate certification, and quality standards differ across borders. Each project master plan should include a permitting roadmap naming the competent authority for each installation type and the expected timeline.

Table 2. *Priority transnational projects and the shared barriers they address.*

Transnational project	Shared barrier it addresses	Value chain focus
Coordinated maritime demand aggregation	Absence of committed maritime offtakers	Distribution to end use
Staged, modular bunkering roll-out with shared learning	First-mover disadvantage; knowledge deficit; personnel shortage	Production to distribution to end use

Transnational project	Shared barrier it addresses	Value chain focus
Shared operational and safety incident database	Knowledge deficit; limited knowledge sharing	Across all segments
Joint permitting roadmaps and one-stop-shop design	Fragmented standards; knowledge deficit in authorities	Distribution to end use
Inter-port operational personnel exchange and training	Shortage of trained operational personnel	Distribution to end use

5.2 Working together to remove governance barriers

Governance barriers are where collaboration has its clearest advantage, because individual ports cannot resolve them within their own national systems.

5.2.1 Speak to the EU with one voice on regulatory certainty

The most damaging governance failure is uncertainty around the certification rules for renewable fuels of non-biological origin under Commission Delegated Regulation (EU) 2023/1184, since offtakers cannot sign contracts around rules that may change. With the Commission now revising these rules (ERGaR, 2026; Hydrogen Europe, 2026), the network should press collectively, through the North Sea Commission, for stable long-term rules and grandfathering for projects already under development.

5.2.2 Press jointly for demand-side mechanisms alongside production support

Without demand-side support, the business case is not reached. Germany's combination of production and demand-side support gives it a more complete incentive landscape than its neighbours (BMWK, 2024). The network should advocate jointly for demand-side mechanisms alongside production support, including instruments such as H2Global, in which a public intermediary buys from producers and resells to end users (H2Global Foundation, n.d.). This is most urgent for Brest and Den Helder.

5.2.3 Rethink backbone access governance and support harmonisation

The governance model for backbone access matters more than the infrastructure itself. Denmark's underwriting unlocked producer commitments (State of Green, 2025), while Den Helder waits for the final phase of the Dutch roll-out. The network should press national governments and transmission system operators to apply the Danish model more widely, and support cross-border harmonisation of procedures and quality standards through the European Network of Network Operators for Hydrogen (Regulation (EU) 2024/1789; European Commission, 2025).

5.2.4 Diffuse knowledge beyond consortium boundaries

Knowledge generated within projects does not reliably reach new entrants, authorities or the operational workforce. Open safety and permitting databases, port personnel training and standard guidance for authorities would reduce barriers in every region, as Den Helder's conversion of a project solution into a transferable policy instrument shows.

Table 3. *Governance barriers and the collaborative remedy.*

Governance barrier	Level of action	Collaborative remedy
Uncertainty over RFNBO certification rules	EU	Collective advocacy via the North Sea Commission for stable, long-term rules and grandfathering for first movers
Absence of demand-side mechanisms	EU and national	Joint case for demand support and for intermediary purchase mechanisms alongside production subsidy
Delayed and unequal backbone access	National and network operators	Advocate the Danish underwriting model; keep imports under consideration as a complement
Fragmented certification and quality standards	EU and transnational	Support harmonisation through the European Network of Network Operators for Hydrogen
Weak diffusion of knowledge to outsiders	Regional and network	Shared safety, permitting and technical databases; port personnel training

5.3 Creating a wider North Sea hydrogen valleys network

The existing networks were built to share knowledge and to advocate, not to coordinate demand or align commitments. Building a wider network therefore means adding a coordination capability rather than enlarging what already exists.

5.3.1 Move from a knowledge network to a coordination network

The wider network should translate relationships into matched supply and demand: convening producers and offtakers around aggregated commitments, maintaining a shared pipeline of demand and supply, and brokering commitments no single port can make alone. The demand aggregation mechanism in Section 5.1.2 is its first function.

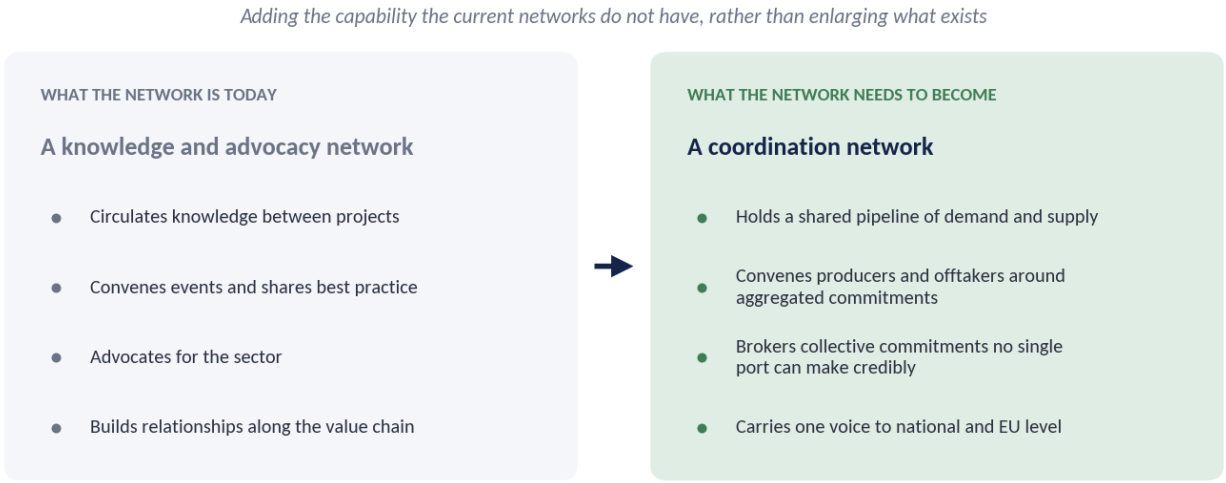


Figure 3. *From a knowledge network to a coordination network.*

5.3.2 Design participation to match each partner's capacity

Port authorities are operational rather than project organisations, and several are experiencing fatigue from repeated requests to join initiatives. Where a partner is reluctant to lead, the network should find a role that matches its capacity rather than accept its withdrawal.

5.3.3 Give the network a governance structure and a collective voice

A standing network needs a light but real governance structure: a clear coordinating role, regular convening, and defined channels for turning port-level insight into policy input. The North Sea Commission offers a legitimate route to Brussels for the network's collective positions on certification, demand support and backbone access.

5.3.4 Build in resilience against offtaker withdrawal

Aggregated demand across four ports is itself a form of resilience, since no single withdrawal collapses the whole signal. The network should also encourage a portfolio of offtake commitments rather than dependence on one anchor, and protect legitimacy as a shared asset.

5.3.5 Extend the network as it matures

The four ports are a starting core, not a closed group. The network can deepen by drawing in adjacent ports, industrial clusters and transmission system operators, and widen by connecting to parallel hydrogen valley initiatives across the North Sea and Atlantic, but only as fast as its structure can absorb.

6. Conclusion: sequenced way forward

Bremen, Brest, Den Helder and Esbjerg share one structure and one set of mutually reinforcing barriers. These barriers cannot be solved port by port; they can only be resolved by aligned action across the network.

The phased path below separates what the network can begin now from what depends on national and EU decisions it can influence but not determine.

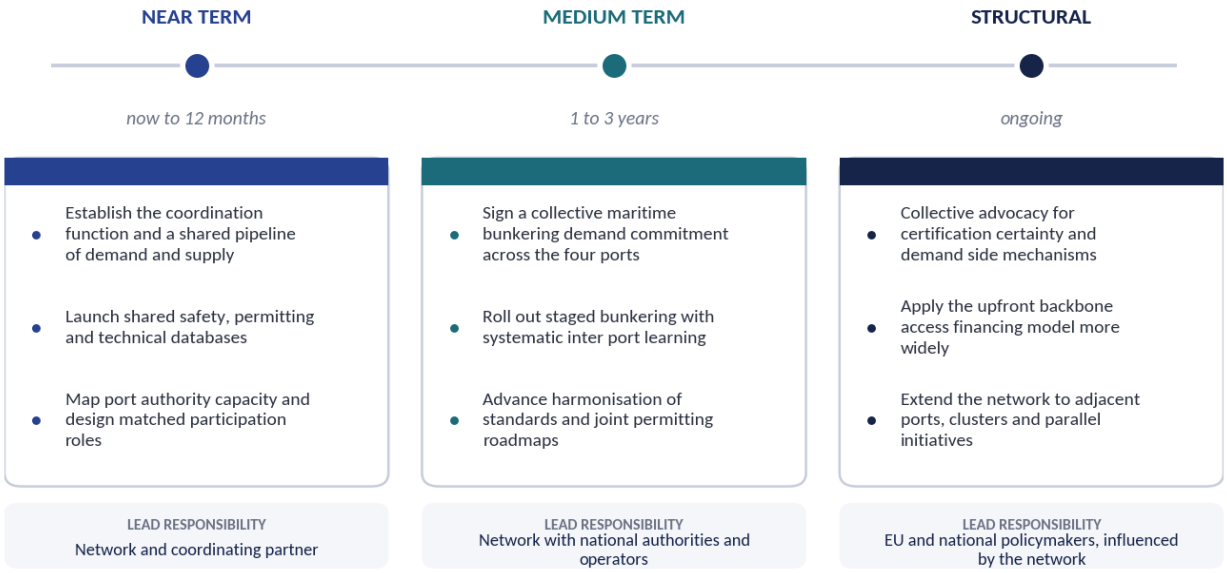


Figure 4. *A phased path for North Sea collaboration.*

Those public decisions, and the network's ability to influence them with one voice, will determine whether the North Sea hydrogen valleys become a genuinely connected system or remain a set of well-connected but commercially unviable pilots.

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